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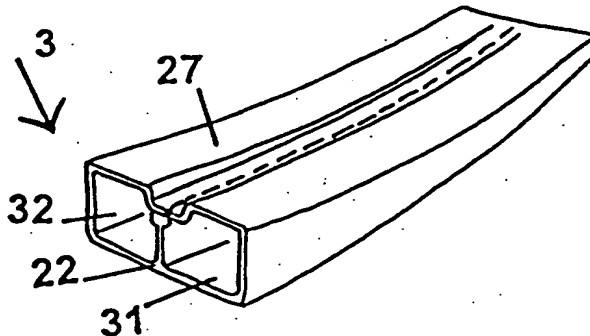
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: <b>PCT/NO99/00375</b></p> <p>(22) International Filing Date: <b>10 December 1999 (10.12.99)</b></p> <p>(30) Priority Data: 19985846                    14 December 1998 (14.12.98)      NO</p> <p>(71) Applicant (<i>for all designated States except US</i>): <b>NORSK HYDRO ASA [NO/NO]; N-0240 Oslo (NO).</b></p> <p>(72) Inventor; and</p> <p>(75) Inventor/Applicant (<i>for US only</i>): <b>VOLD, Rolf [NO/NO]; Rudslåtten, N-2830 Raufoss (NO).</b></p> <p>(74) Agent: <b>RICANEK, Ivan; Norsk Hydro ASA, N-0240 Oslo (NO).</b></p>		<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b>  <i>With international search report.</i>  <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: METHOD OF MANUFACTURING STRUCTURAL MEMBERS

## (57) Abstract

A novel method of manufacturing structural members having closed cross-sectional configuration comprises steps of providing an open member (2) followed by reshaping/folding of its lateral parts and joining of abutted side walls into a co-extruded supporting longitudinally extending rib (21). The resulting structural member is preferentially a part of a vehicle body structure, e.g. a bumper beam.



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### **"Method of manufacturing structural members"**

The present invention relates to a method of manufacturing longitudinal structural members having closed cross-sectional configuration, more particularly to manufacturing of bumper beams for vehicles and also to the members provided by such method.

Such longitudinal structural members, particularly the members made of Al or Al-alloys, are presently provided by extruding closed shapes having the required cross-sectional configuration and wall thickness in one operation.

However, provision of structural members like bumper beams for vehicles by simply extruding a double chamber closed shape is not offering a low cost, flexible manufacturing method ensuring simultaneously the lowest possible weight of the members. This is due to a number of disadvantages inherent to the extrusion process such as low extruding speed, increased die wear, limited choice of alloys and possibility for provision of thinner walls.

Furthermore, cross-sectional variations along the longitudinal extension of the members, often required due to limited available space or specific performance requests to structural members, are achieved by subsequent re-shaping/deformation of the cross-sectional configuration on pre-determined locations.

It is therefore an object of the present invention to provide a new method of manufacturing longitudinal structural members of closed cross-sectional configuration offering more freedom with regard to the functional configuration of the members and low material consumption.

A further object of the present invention is to provide a cheap manufacturing method and low weight structural members.

These and other objects are achieved in accordance with the present invention by provision of a novel manufacturing method and the resulting members as it appears from the attached patent claims 1 and 5.

Specific features and advantages of the present invention will be apparent from the following detailed descriptions of preferred embodiments of the structural beam with reference to the accompanying drawings, Figs. 1-5, where

- Fig. 1 is a schematical perspective view of an extruded open member,
- Fig. 2 illustrates schematically in a perspective view steps of reshaping and removing of excess material from the open member,
- Fig. 3 is a schematical perspective view of the reshaped member prior to the folding step of interim side walls,
- Figs. 4a,b show the formed closed shape member with abutted inwardly extending flanges ready for the final joining operation, and
- Figs. 5a,b illustrate schematically in a perspective and a vertical cross-sectional view, respectively, another embodiment of the member having a constant height along its longitudinal extension.

Referring to Figs. 1-4 illustrating by way of example the individual steps of manufacturing a bumper beam according to the present invention, only a half of the beam divided by a centre line OY-OY is shown in order to facilitate focusing on the preferred embodiment of the beam exhibiting variation in height and provision of a channel recession along the beam to protect the welded seam as a preferred type of joint.

Figure 1 shows in a schematical perspective view an open extruded member 2 comprising a base portion 21 provided with a rib 22 protruding longitudinally along the member.

Inherent advantages of extruding an open member compared to a closed shape configurated member is a higher extruding speed, less wear of the extruding tool (die), larger choice of applicable alloys and possibility of weight-optimizing of the member by provision of thinner walls when and where appropriate.

Figure 2 illustrates schematically provision of lateral flanges 23,24 by means of any suitable method like e.g. pressing, rolling etc., followed optionally by gradual reduction of the flanges' lateral extension in the direction towards the end of the member by removal/cutting of material as depicted by the hatched fields.

Figure 3 illustrates an interim stage of the reshaping process from open to a closed shape configuration of the member 2 comprising provision of interim side walls 25,26 followed by a further reshaping step along the dotted lines, thereby folding the interim side walls 25,26 into a top portion 27 of a closed shape member by abutting the lateral flanges 23,24 on the top of the longitudinally extending rib 22 as shown in Figure 4a, followed by a joining/welding operation.

Figure 4b shows the formed closed shape member 3 in a preferred embodiment suitable for use as a bumper in vehicles exhibiting a channel-like recession 35 accommodating/protecting a welding seam (joint) 36 joining the abutted flanges 23,24 and the rib 22, thereby providing two separate chambers 31,32.

Advantageously, thanks to the optional provision of flanges 23,24 exhibiting varying width, the channel recession 35 and thus the whole height H of the beam 3 is decreasing from the OY central line towards the end(s) as illustrated in a perspective view in Fig. 4a. This flexibility with regard to variation of cross-sectional area of the bumper beam is an important advantage resulting from the novel manufacturing method according to the present invention.

Customarily this effect is achieved by deforming (folding) of side walls of readily closed shape extruded members, thus increasing both the weight of the beam, the material consumption and thus the cost of the beams.

Although the present invention has been described and illustrated with respect to the preferred features and manner of manufacturing and preferred embodiments, it is to be understood that various changes and modifications may be made to the specifically described and illustrated arrangements without departing from the scope of the present invention.

Thus Figure 5 illustrates schematically in a perspective view and a cross-sectional view, respectively, a simplified embodiment of the structural member 3 exhibiting a constant height along its longitudinal extrusion. The interim side walls 25,26 from Figure 3 are in this case without provision of any lateral flanges directly folded into a top portion of the thereby provided closed shape member 3 being abutted and joined (welded) along the rib 22 providing two separate chambers 31,32.

Apart from the disclosed joining based on welding of the abutted walls of the member (preferentially friction stir welding), any other conventional joining techniques may be applied depending on the actual demand/performance to the structural member.

Consequently, structural members for different purposes having variation in the cross-sectional configuration, or constant cross-section with option for cutting of members having desired length, can be manufactured according to the present invention.

Claims

1. Method of manufacturing longitudinally extending structural members having a closed cross-sectional configuration comprising two or more chambers, said method comprising steps of
  - extruding an open member (2) having a base portion (21) provided with at least one longitudinally protruding rib (22),
  - reshaping of lateral parts of the member into a pair of interim side walls (25,26),
  - folding the interim side walls (25,26) into a top portion (27) of the thereby formed closed shape member (3) by bringing the folded abutted side walls to rest on the longitudinally extending rib (21), and finally
  - joining of the abutted side walls and the supporting rib(s) together by any suitable joining technique known per se.
2. Method according to claim 1,  
characterized in that  
the step of reshaping of the lateral parts of the open member (2) further comprises provision of lateral flanges (23,24).
3. Method according to claim 2,  
characterized in that  
excess material from the base portion (21) is cut prior to the reshaping step to provide inwardly extending flanges (23,24) exhibiting a varying height along the longitudinal extension of the folded closed shape member.
4. Method according to claim 1,  
characterized in that  
the joining of abutted walls is conducted by friction stir welding.

5. Structural member, particularly for application in a vehicle body structure comprising a hollow shape (3), where the cavity of the hollow shape is longitudinally divided into two or more chambers (31,32) by means of dividing rib(s) (22),  
characterized in that  
said rib(s) are integral co-extruded part(s) of open extruded member (2) providing a support for a joint (36) connecting the abutted walls of the folded member (2).
6. Structural member according to claim 5,  
characterized in that  
the hollow shape exhibits varying cross-sectional area along its longitudinal extension.
7. Structural member according to claim 5 or 6,  
characterized in that  
the joint (36) is a welded seam located in a channel-like recession (35) provided along said member's longitudinal extension by a pair of inwardly extending flanges (23,24).
8. Structural member according to one or more preceding claims,  
characterized in that  
the member is a bumper beam for vehicles.

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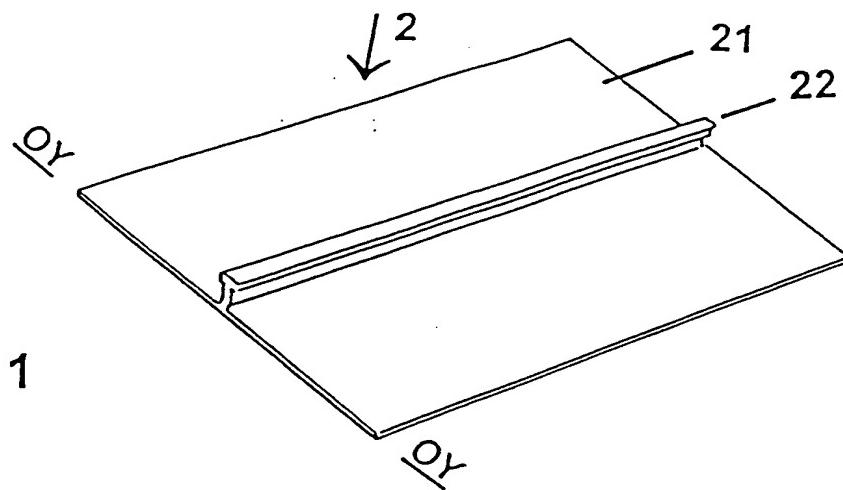


Fig. 1

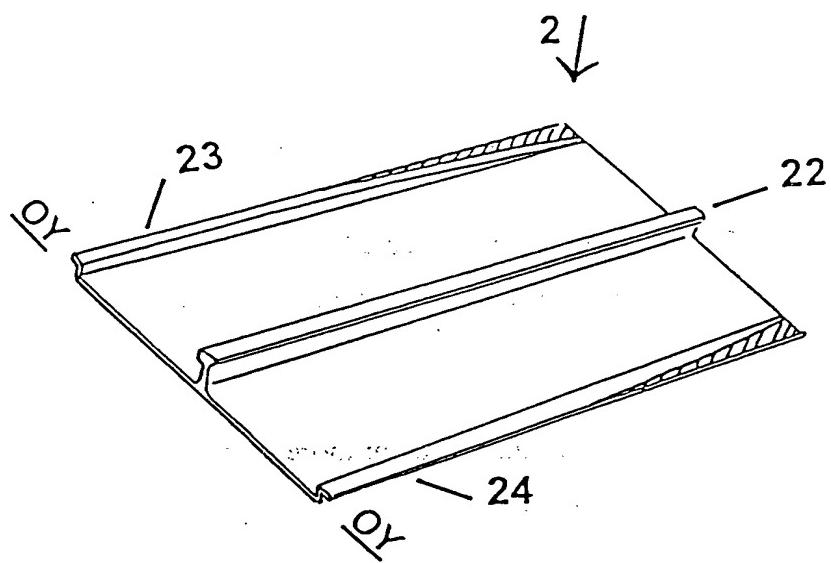


Fig. 2

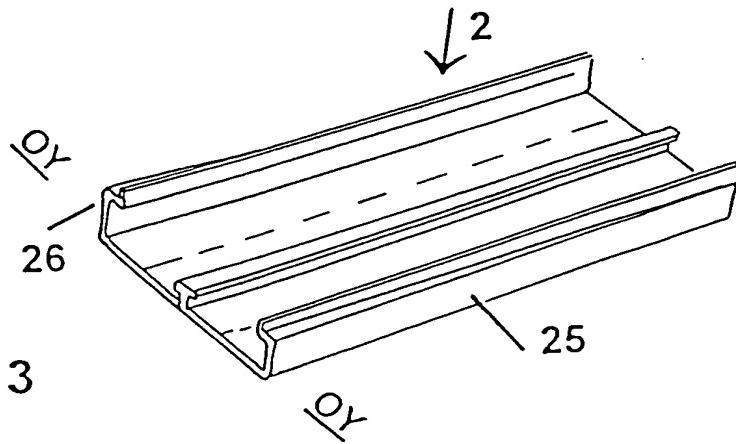


Fig. 3

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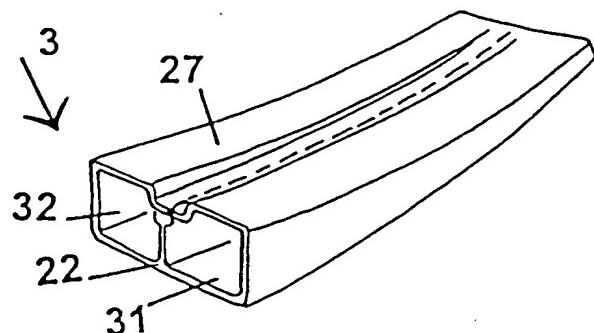


Fig. 4a

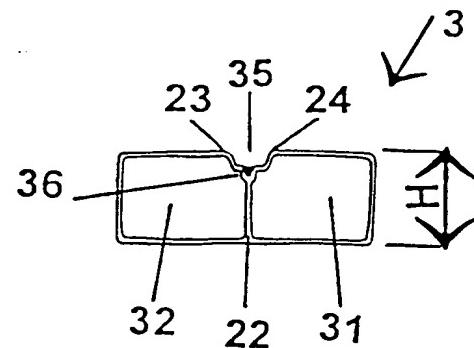


Fig. 4b

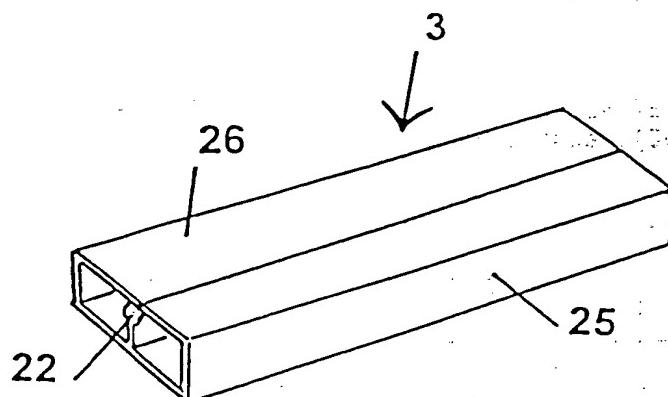


Fig. 5a

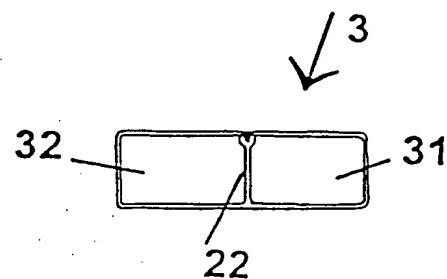


Fig. 5b

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 99/00375

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B21C 23/14 // B60R 019/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B21C, B60R, B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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EPODOC, WPI, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9915365 A1 (NORSK HYDRO ASA), 1 April 1999 (01.04.99), figure 1 --	1-8
A	US 5540016 A (EDVIN L. CLAUSEN), 30 July 1996 (30.07.96), figure 1, abstract --	1-8
A	EP 0233552 A1 (METZELER KAUTSCHUK GMBH), 26 August 1987 (26.08.87), figures 1,2 --	1-8
A	US 5085902 A (YUKIHIKO YADA ET AL), 4 February 1992 (04.02.92), abstract -----	1-8

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9915365 A1	01/04/99	AU NO	9284698 A 974375 A	12/04/99 23/03/99
US 5540016 A	30/07/96	AT DE EP ES JP NO WO	109411 T 69103257 D,T 0510060 A,B 2061231 T 5503053 T 900109 A 9110582 A	15/08/94 23/03/95 28/10/92 01/12/94 27/05/93 10/07/91 25/07/91
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